

In re Patent Application of:
CAIN ET AL.
Serial No. 10/658,022
Filing Date: SEPTEMBER 9, 2003

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In the Claims:

1. (Original) A mobile ad hoc network (MANET) comprising:

a plurality of mobile nodes each comprising a wireless communications device and a controller connected thereto;

 said controller operating in accordance with a multi-layer protocol hierarchy for,

 at an application layer, establishing a quality-of-service (QoS) threshold;

 at a QoS support layer below the application layer, determining whether to require data reception acknowledgements based upon the QoS threshold;

 at a QoS coding layer below the QoS support layer, encoding data from the application layer for transmission to at least one destination mobile node;

 at a QoS route selection layer below the QoS coding layer, selecting at least one route to the at least one destination mobile node based upon the QoS threshold;

 at a QoS traffic layer below the QoS route selection layer, controlling data traffic flow based upon the QoS threshold; and

 at at least one lower protocol layer below the QoS traffic layer, cooperating with said wireless communications device to transmit data to the at least

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one destination mobile node via the at least one selected route.

2. (Original) The MANET of Claim 1 wherein, at a QoS forwarding layer between the QoS route selection layer and QoS traffic layer, selecting between a unicast communications mode and a multicast communications mode based upon the QoS threshold; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to transmit the data based upon the selected communications mode.

3. (Original) The MANET of Claim 1 wherein the at least one lower protocol layer comprises a radio adaptation layer providing an interface for the QoS traffic layer.

4. (Original) The MANET of Claim 1 wherein the at least one lower protocol layer comprises a media access layer.

5. (Original) The MANET of Claim 1 wherein the at least one lower protocol layer comprises a physical layer.

6. (Original) The MANET of Claim 5 wherein, at the physical layer, said controller cooperates with said wireless communications device to determine a QoS metric for the at least one selected route; wherein, at the QoS route selection layer, said controller determines whether the QoS metric falls below the QoS threshold; and wherein, at the physical layer, said

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controller cooperates with said wireless communications device to adjust at least one signal characteristic based upon a determination that the QoS metric has fallen below the QoS threshold.

7. (Original) The MANET of Claim 6 wherein the at least one signal characteristic comprises at least one of power, gain, and signal pattern.

8. (Original) The MANET of Claim 1 wherein, at the QoS support layer, said controller determines whether to admit traffic from other mobile nodes based upon respective QoS route requests received therefrom and an internal QoS metric.

9. (Original) The MANET of Claim 8 wherein the QoS route requests have respective traffic flow identifiers and second QoS thresholds associated therewith; and wherein, at the QoS traffic layer, said controller further polices admitted traffic based upon respective traffic flow identifiers to ensure that the admitted traffic does not exceed respective second QoS thresholds.

10. (Original) The MANET of Claim 8 wherein the internal QoS metric comprises at least one of available power, available bandwidth, recent error rate, and recent delay.

11. (Original) The MANET of Claim 1 wherein, at the

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QoS packet coding layer, said controller:

encodes data using a forward error correction (FEC) algorithm to generate error correction data for the data based upon the QoS threshold, and

interleaves the error correction data and the data prior to transmission thereof.

12. (Original) The MANET of Claim 1 wherein, at the QoS route selection layer, said controller performs load-leveling on outgoing data based upon the QoS threshold and an energy usage level required to transmit the outgoing data.

13. (Original) The MANET of Claim 1 wherein said wireless communications device operates over a plurality of channels; wherein the selected route is associated with one of the plurality of channels; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to scout at least one other available channel when a QoS level of the selected route falls below the QoS threshold.

14. (Original) A mobile ad hoc network (MANET) comprising:

a plurality of mobile nodes each comprising a wireless communications device and a controller connected thereto;

said controller operating in accordance with a multi-layer protocol hierarchy for,

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at an application layer, establishing a quality-of-service (QoS) threshold;

at a QoS support layer below the application layer, determining whether to require data reception acknowledgements based upon the QoS threshold;

at a QoS coding layer below the QoS support layer, encoding data from the application layer for transmission to at least one destination mobile node;

at a QoS route selection layer below the QoS coding layer, selecting at least one route to the at least one destination mobile node based upon the QoS threshold;

at a QoS traffic layer below the QoS route selection layer, controlling data traffic flow based upon the QoS threshold;

at a physical layer below the QoS traffic layer, cooperating with said wireless communications device to transmit data to the at least one destination mobile node via the at least one selected route; and

at a radio adaptation layer between the physical layer below the QoS traffic layer, providing an interface between the physical device and QoS traffic layer.

15. (Original) The MANET of Claim 14 wherein, at a QoS forwarding layer between the QoS route selection layer and QoS traffic layer, selecting between a unicast communications mode

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and a multicast communications mode based upon the QoS threshold; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to transmit the data based upon the selected communications mode.

16. (Original) The MANET of Claim 14 wherein, at a media access layer between the radio adaptation layer and the physical layer, said controller performs media access operations.

17. (Original) The MANET of Claim 14 wherein, at the physical layer, said controller cooperates with said wireless communications device to determine a QoS metric for the at least one selected route; wherein, at the QoS route selection layer, said controller determines whether the QoS metric falls below the QoS threshold; and wherein, at the physical layer, said controller cooperates with said wireless communications device to adjust at least one signal characteristic based upon a determination that the QoS metric has fallen below the QoS threshold.

18. (Original) The MANET of Claim 17 wherein the at least one signal characteristic comprises at least one of power, gain, and signal pattern.

19. (Original) The MANET of Claim 14 wherein, at the QoS support layer, said controller determines whether to admit traffic from other mobile nodes based upon respective QoS route

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requests received therefrom and an internal QoS metric.

20. (Original) The MANET of Claim 19 wherein the QoS route requests have respective traffic flow identifiers and second QoS thresholds associated therewith; and wherein, at the QoS traffic layer, said controller further polices admitted traffic based upon respective traffic flow identifiers to ensure that the admitted traffic does not exceed respective second QoS thresholds.

21. (Original) The MANET of Claim 19 wherein the internal QoS metric comprises at least one of available power, available bandwidth, recent error rate, and recent delay.

22. (Original) The MANET of Claim 14 wherein, at the QoS packet coding layer, said controller:

encodes data using a forward error correction (FEC) algorithm to generate error correction data for the data based upon the QoS threshold, and

interleaves the error correction data and the data prior to transmission thereof.

23. (Original) The MANET of Claim 14 wherein, at the QoS route selection layer, said controller performs load-leveling on outgoing data based upon the QoS threshold and an energy usage level required to transmit the outgoing data.

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24. (Original) The MANET of Claim 14 wherein said wireless communications device operates over a plurality of channels; wherein the selected route is associated with one of the plurality of channels; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to scout at least one other available channel when a QoS level of the selected route falls below the QoS threshold.

25. (Original) A method for operating a mobile node in a mobile ad hoc network (MANET), comprising a plurality of mobile nodes, in accordance with a multi-layer protocol hierarchy, the mobile node comprising a wireless communications device, and the method comprising:

at an application layer, establishing a quality-of-service (QoS) threshold;

at a QoS support layer below the application layer, determining whether to require data reception acknowledgements based upon the QoS threshold;

at a QoS coding layer below the QoS support layer, encoding data from the application layer for transmission to at least one destination mobile node;

at a QoS route selection layer below the QoS coding layer, selecting at least one route to the at least one destination mobile node based upon the QoS threshold;

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at a QoS traffic layer below the QoS route selection layer, controlling data traffic flow based upon the QoS threshold; and

at at least one lower protocol layer below the QoS traffic layer, causing the wireless communications device to transmit data to the at least one destination mobile node via the at least one selected route.

26. (Original) The method of Claim 25 further comprising, at a QoS forwarding layer between the QoS route selection layer and QoS traffic layer, selecting between a unicast communications mode and a multicast communications mode based upon the QoS threshold; and wherein cooperating comprises cooperating with the wireless communications device to transmit the data based upon the selected communications mode.

27. (Original) The method of Claim 25 wherein the at least one lower protocol layer comprises a radio adaptation layer for providing an interface for the QoS traffic layer.

28. (Original) The method of Claim 25 wherein the at least one lower protocol layer comprises a media access layer.

29. (Original) The method of Claim 25 wherein the at least one lower protocol layer comprises a physical layer.

30. (Original) The method of Claim 29 further

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comprising:

at the physical layer, cooperating with the wireless communications device to determine a QoS metric for the at least one selected route;

at the QoS route selection layer, determining whether the QoS metric falls below the QoS threshold; and

at the physical layer, the cooperating with the wireless communications device to adjust at least one signal characteristic based upon a determination that the QoS metric has fallen below the QoS threshold.

31. (Original) The method of Claim 30 wherein the at least one signal characteristic comprises at least one of power, gain, and signal pattern.

32. (Original) The method of Claim 25 further comprising, at the QoS support layer, determining whether to admit traffic from other mobile nodes based upon respective QoS route requests received therefrom and an internal QoS metric.

33. (Original) The method of Claim 32 wherein the QoS route requests have respective traffic flow identifiers and second QoS thresholds associated therewith; and further comprising, at the QoS traffic layer, policing admitted traffic based upon respective traffic flow identifiers to ensure that the admitted traffic does not exceed respective second QoS thresholds.

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34. (Original) The method of Claim 32 wherein the internal QoS metric comprises at least one of available power, available bandwidth, recent error rate, and recent delay.

35. (Original) The method of Claim 25 further comprising, at the QoS packet coding layer:

encoding data using a forward error correction (FEC) algorithm to generate error correction data for the data based upon the QoS threshold, and

interleaving the error correction data and the data prior to transmission thereof.

36. (Original) The method of Claim 25 further comprising, at the QoS route selection layer, performing load-leveling on outgoing data based upon the QoS threshold and an energy usage level required to transmit the outgoing data.

37. (Original) The method of Claim 25 wherein the wireless communications device operates over a plurality of channels; wherein the selected route is associated with one of the plurality of channels; and further comprising, at the at least one lower protocol layer, cooperating with the wireless communications device to scout at least one other available channel when a QoS level of the selected route falls below the QoS threshold.